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Nakazato

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(54) **ENDOSCOPE TIP ATTACHMENT**

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A61B 8/12 (2006.01)
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CPC ***A61B 1/00089*** (2013.01); ***A61B 1/00068*** (2013.01); ***A61B 1/00087*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC A61B 1/0008; A61B 1/00089; A61B 1/00091; A61B 1/00098; A61B 1/00101;
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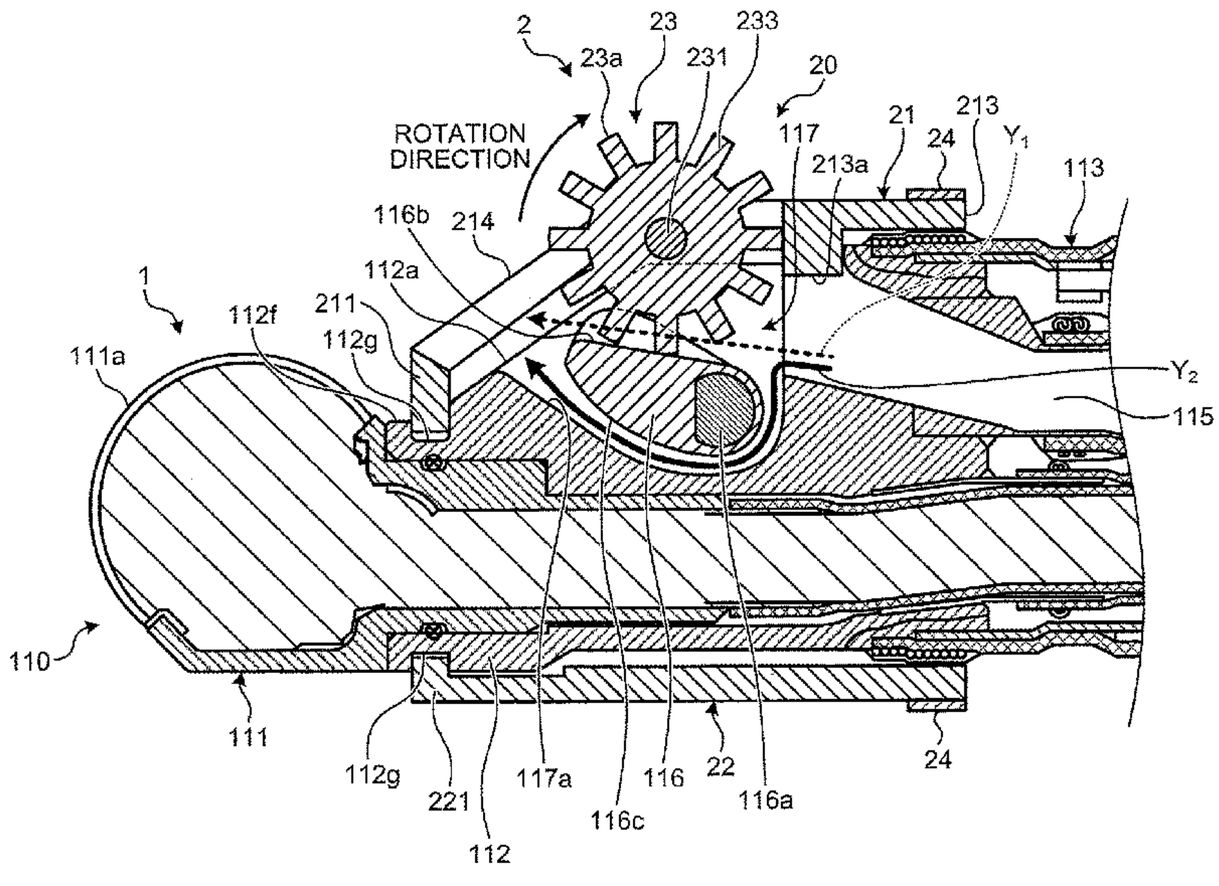
(57) **ABSTRACT**

An endoscope tip attachment includes: a cylindrical casing that is arranged to surround a distal end portion of an endoscope that includes a raising base to raise a treatment tool; and a fluid controller that is positioned at an opening of a treatment-tool insertion channel of the endoscope inside the casing in a state in which the casing is attached to the distal end portion of the endoscope, the fluid controller being configured to control a flow of solution that has flowed from the treatment-tool insertion channel of the endoscope toward the distal end portion of the endoscope to flow equally along an entire surface of the raising base provided at the distal end portion of the endoscope, and being movable by pressure received from the solution.

10 Claims, 9 Drawing Sheets



(51) **Int. Cl.**
A61B 8/00 (2006.01)
A61B 1/12 (2006.01)

(52) **U.S. Cl.**
CPC ***A61B 1/00098*** (2013.01); ***A61B 1/00101*** (2013.01); ***A61B 1/00135*** (2013.01); ***A61B 1/122*** (2013.01); ***A61B 1/125*** (2013.01); ***A61B 1/126*** (2013.01); ***A61B 8/12*** (2013.01); ***A61B 8/445*** (2013.01)

(58) **Field of Classification Search**
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See application file for complete search history.

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FIG.1

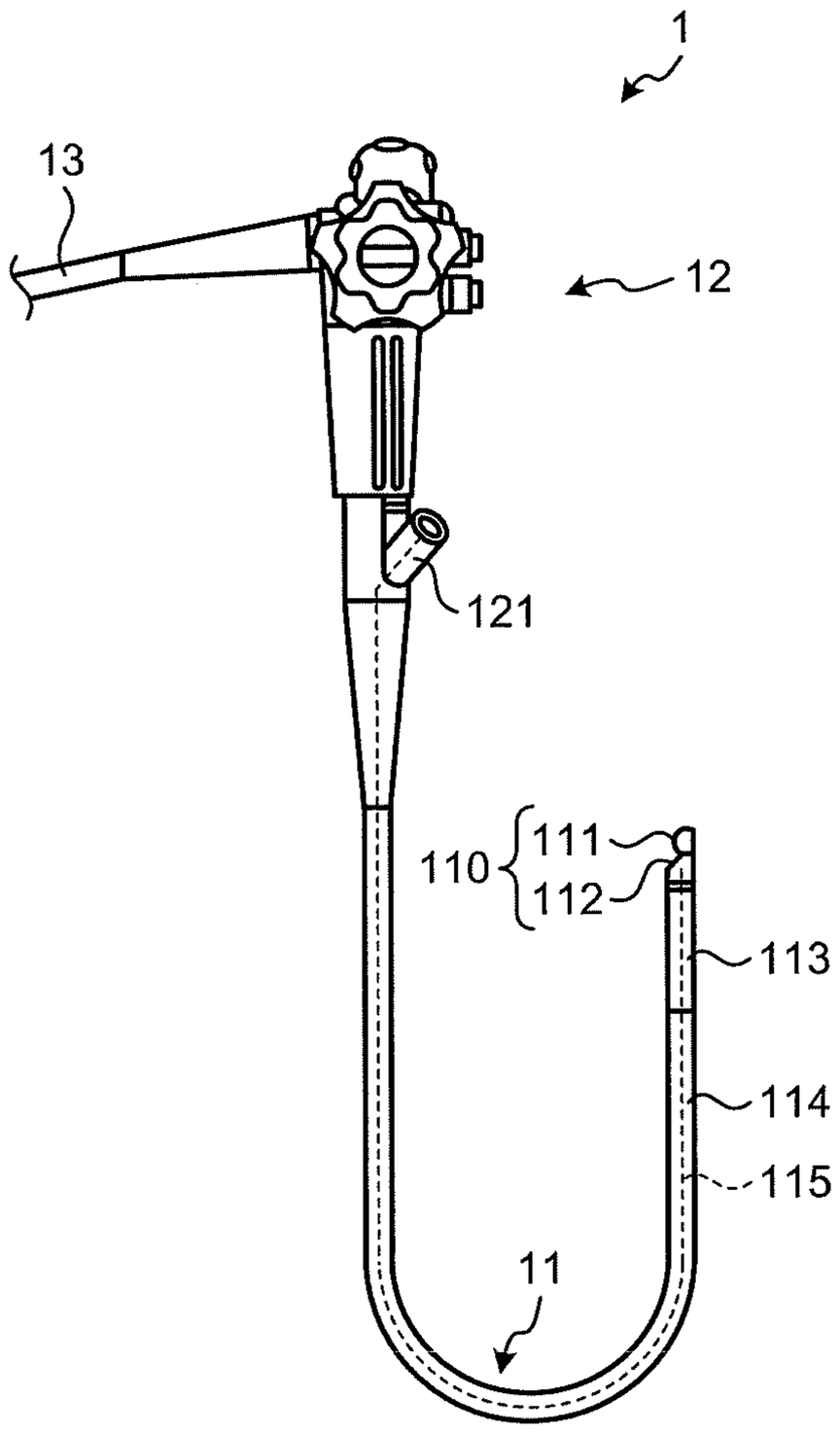


FIG.2

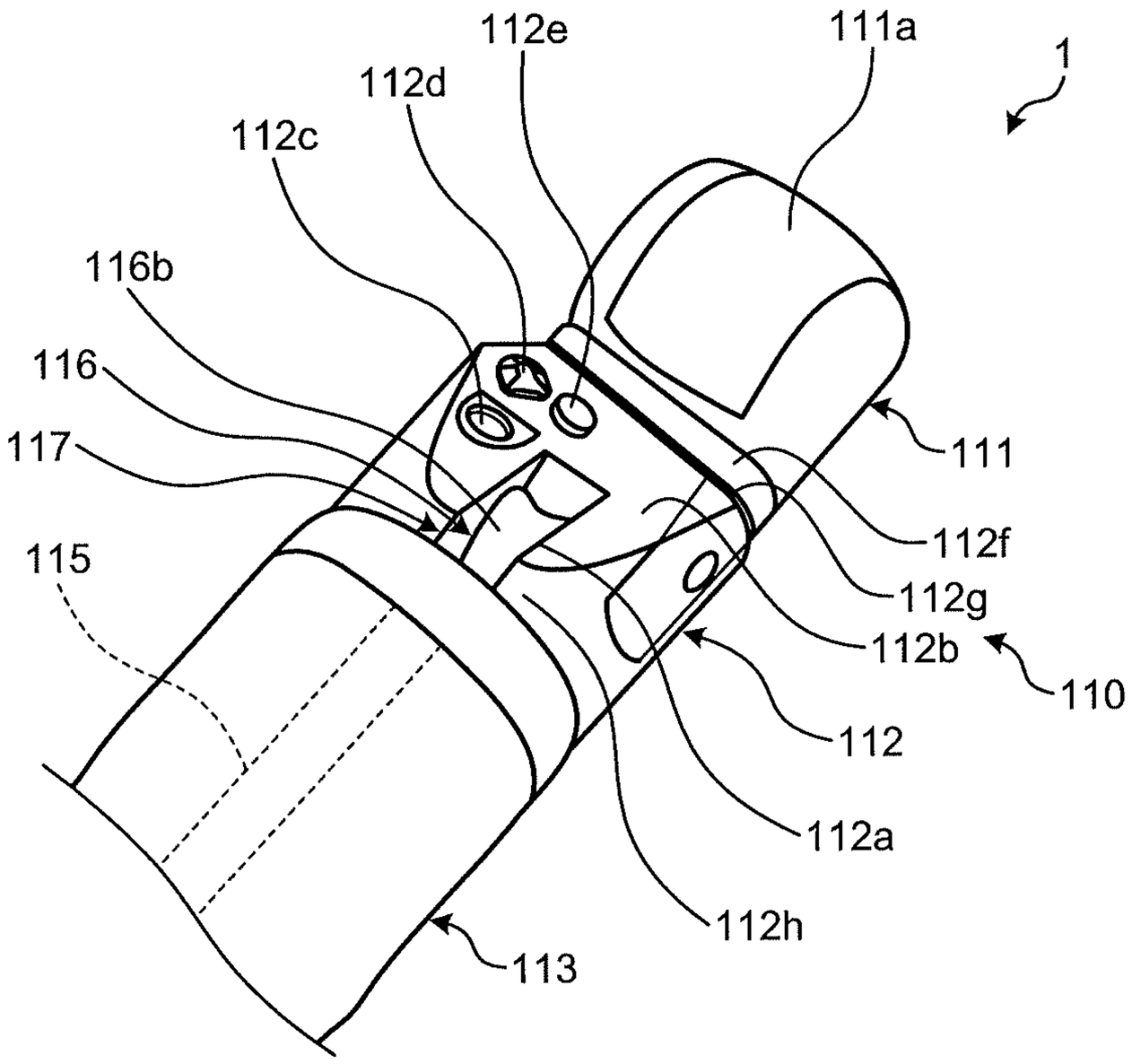

112e
111a
1
112d
112c
116b
116
117
115
111
112f
112g
112b
110
112
112a
112h
113

FIG.3

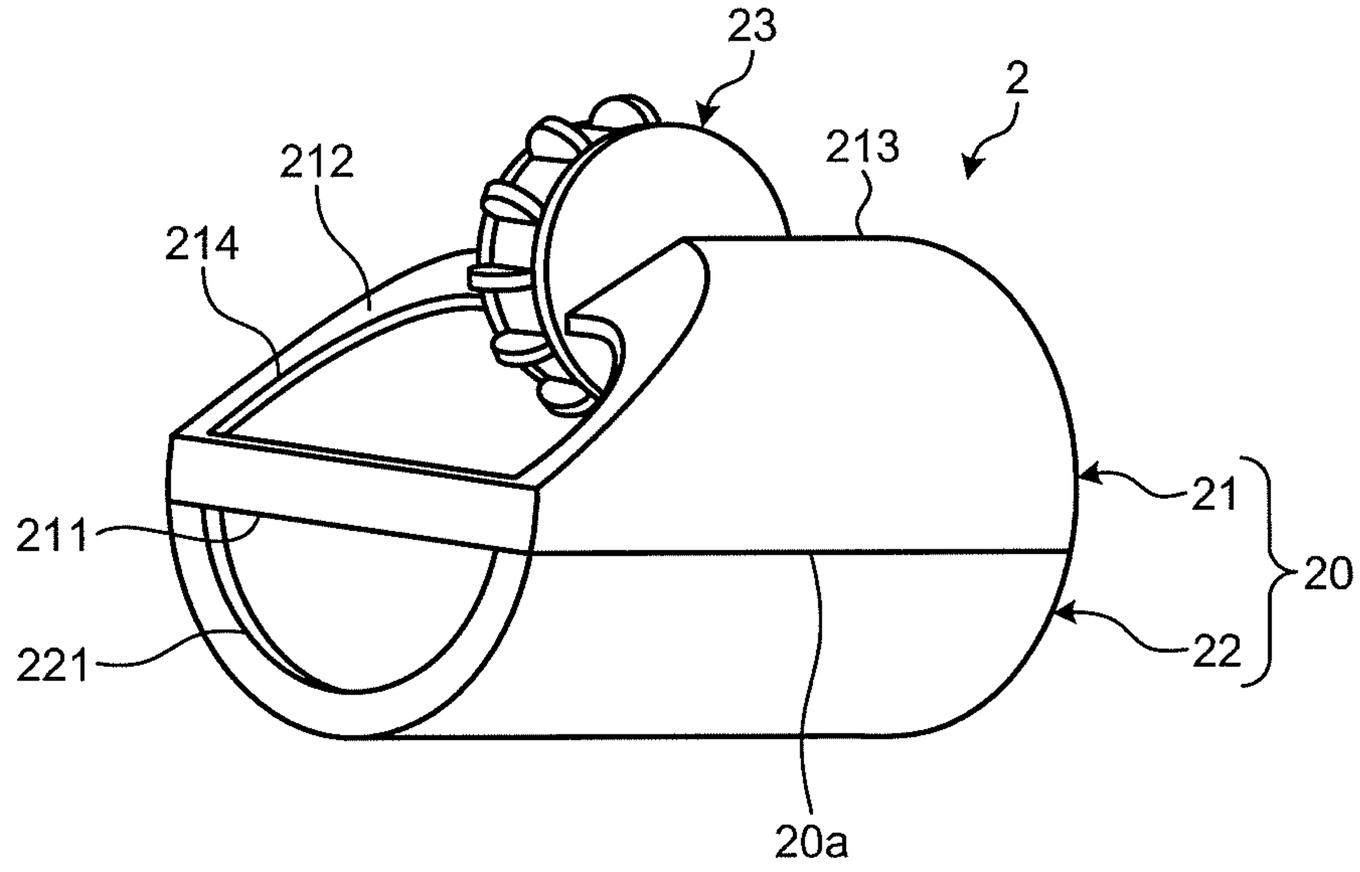

2
212
213
214
21
211
20
221
22
20a

FIG.4

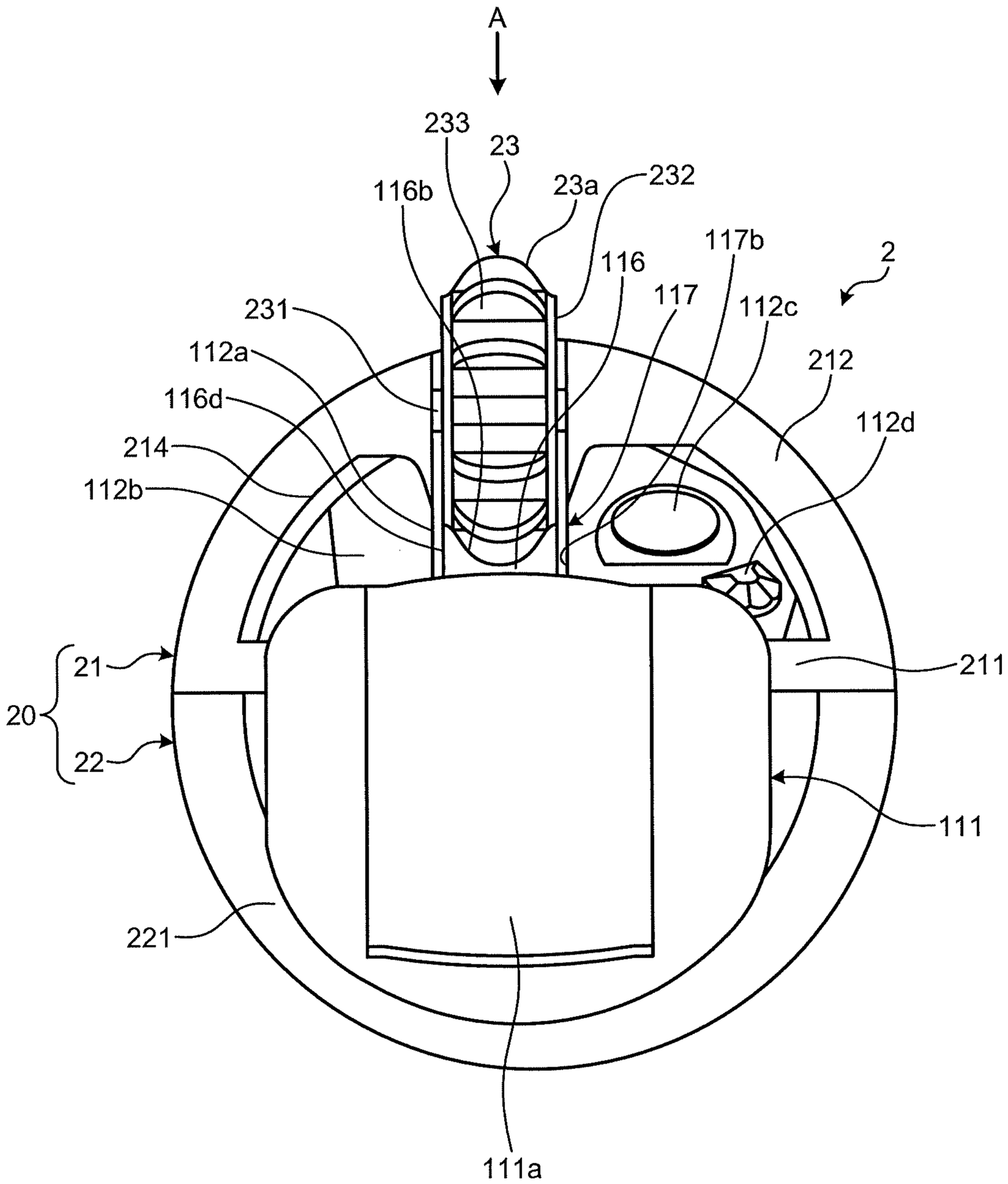

A
233
23
116b
23a
232
117b
116
2
231
117
112c
112a
212
116d
112d
214
112b
211
21
20
22
111
221
111a

FIG.5

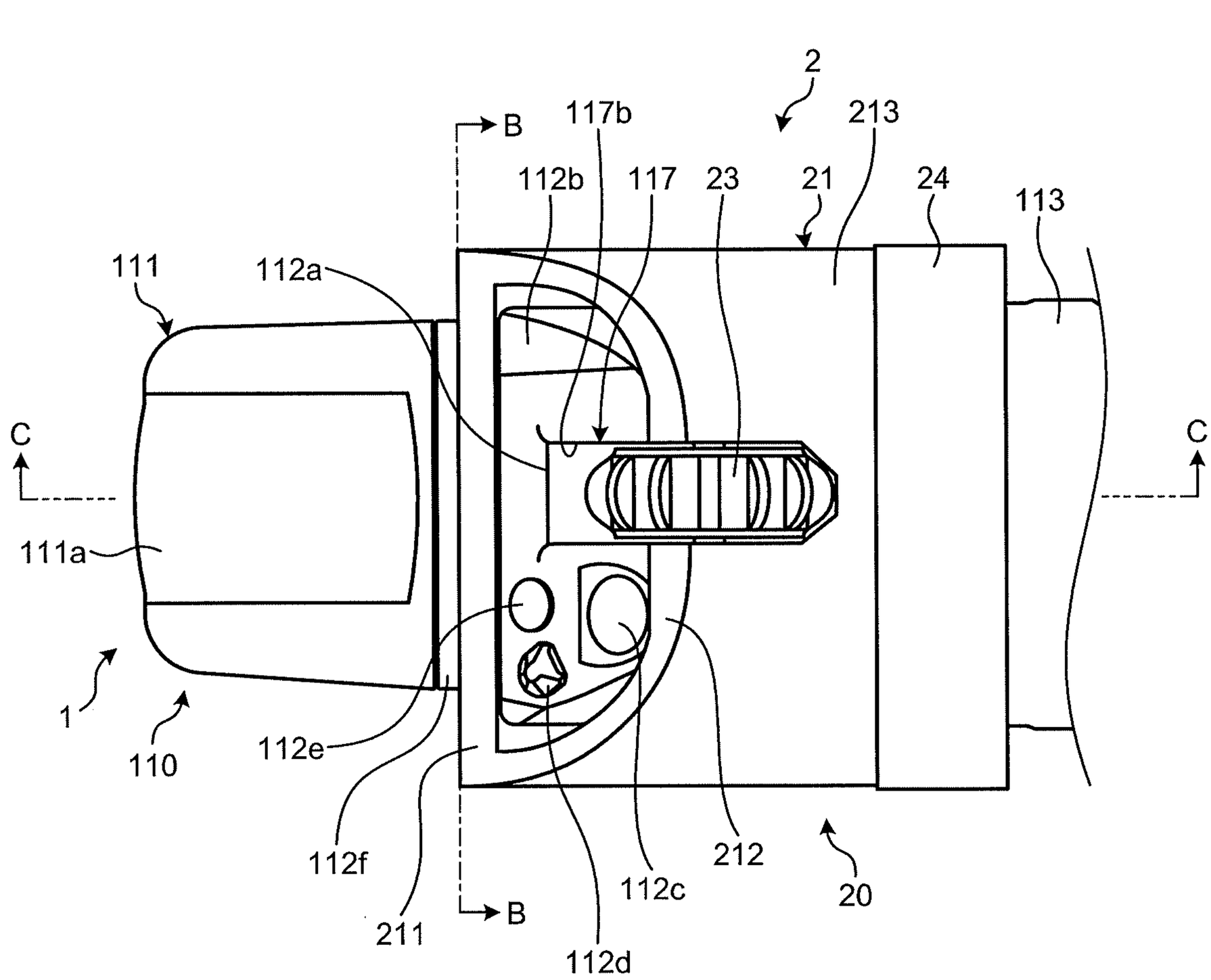

2
B
117b
213
112b
117
23
21
24
113
111
112a
C
C
111a
1
110
112e
112f
211
B
112d
112c
212
20

FIG.6

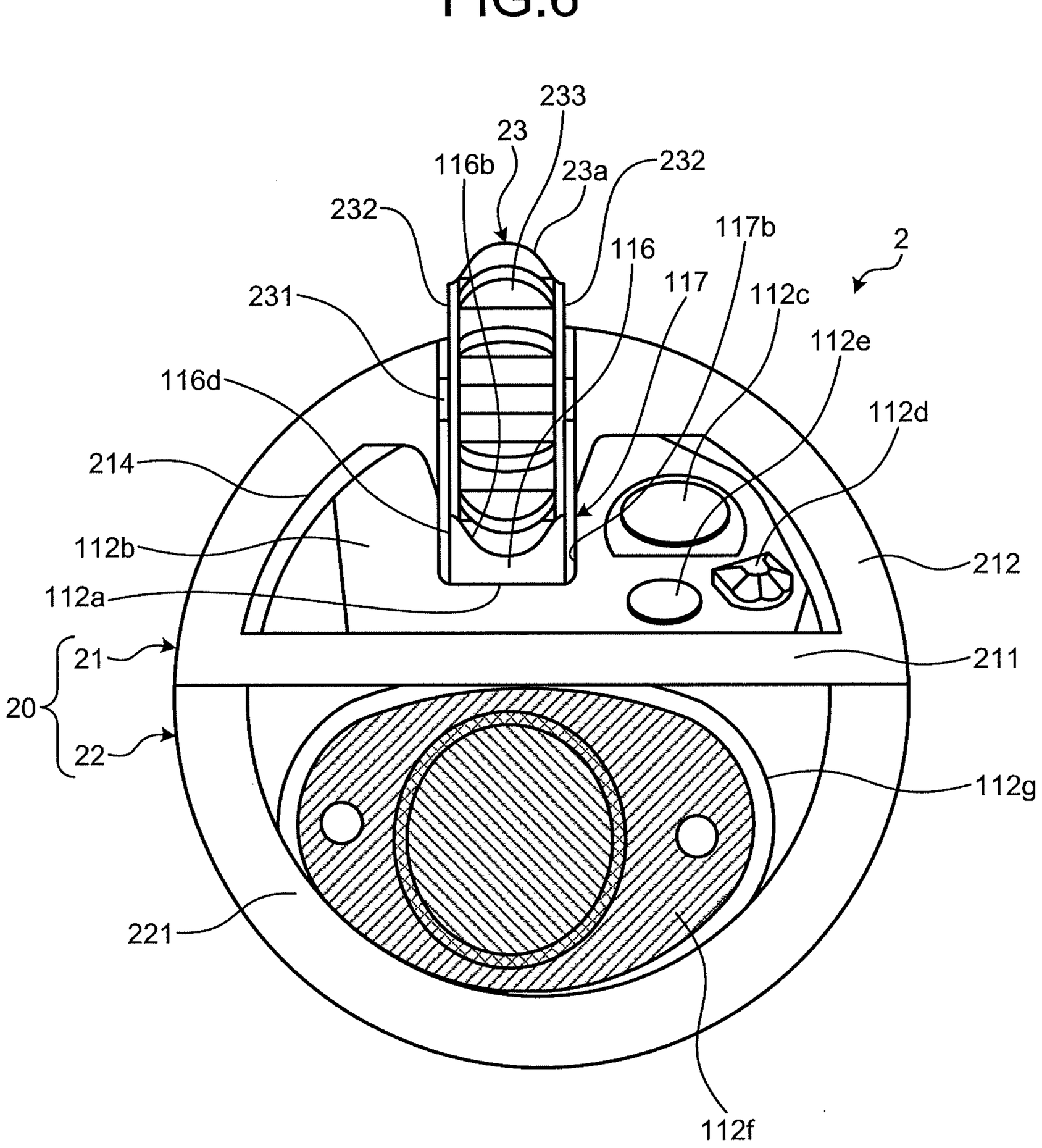

233
23
116b
23a
232
232
117b
2
116
117
231
112c
112e
116d
112d
214
112b
212
112a
21
211
20
22
112g
221
112f

FIG.7

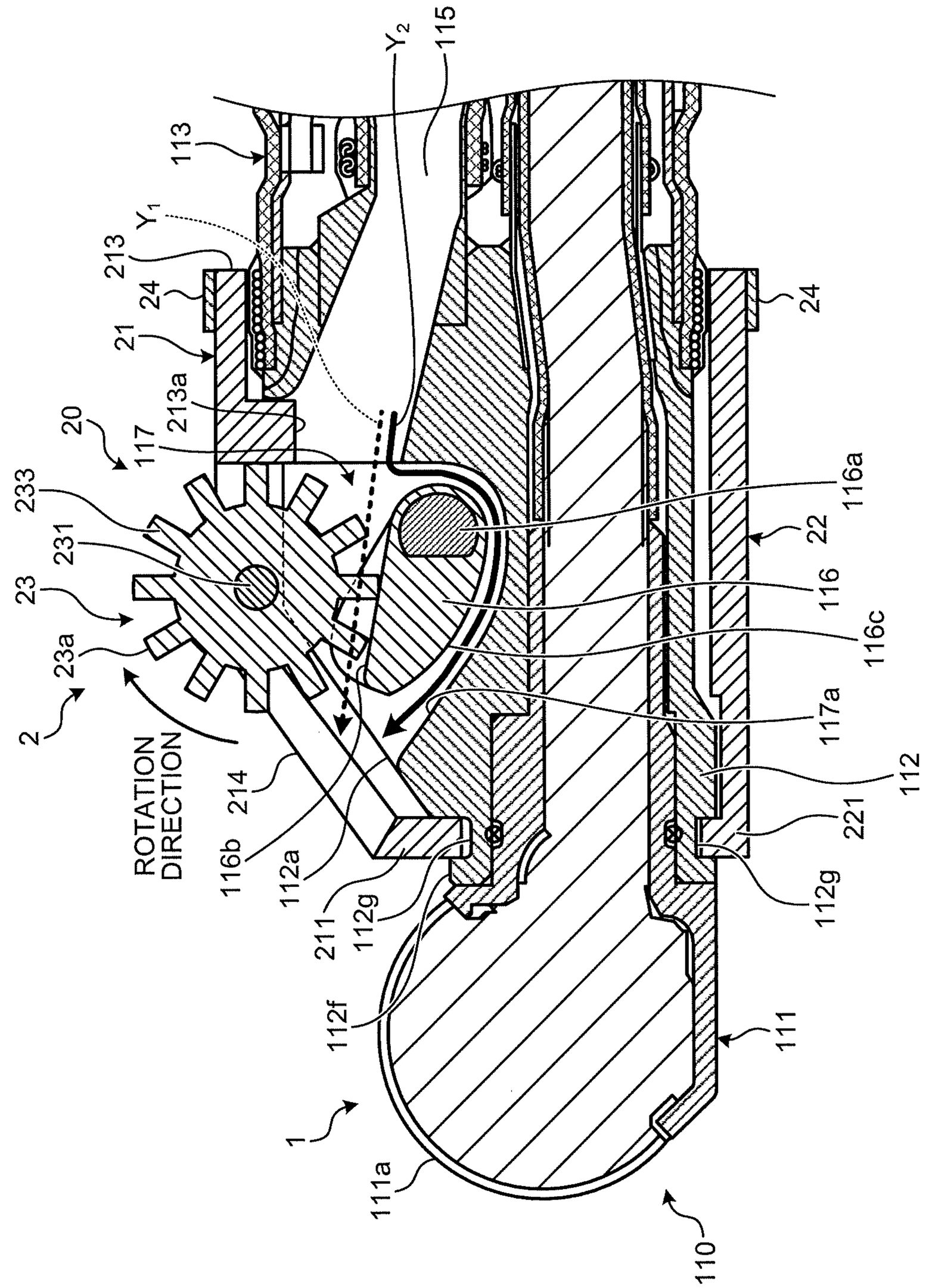
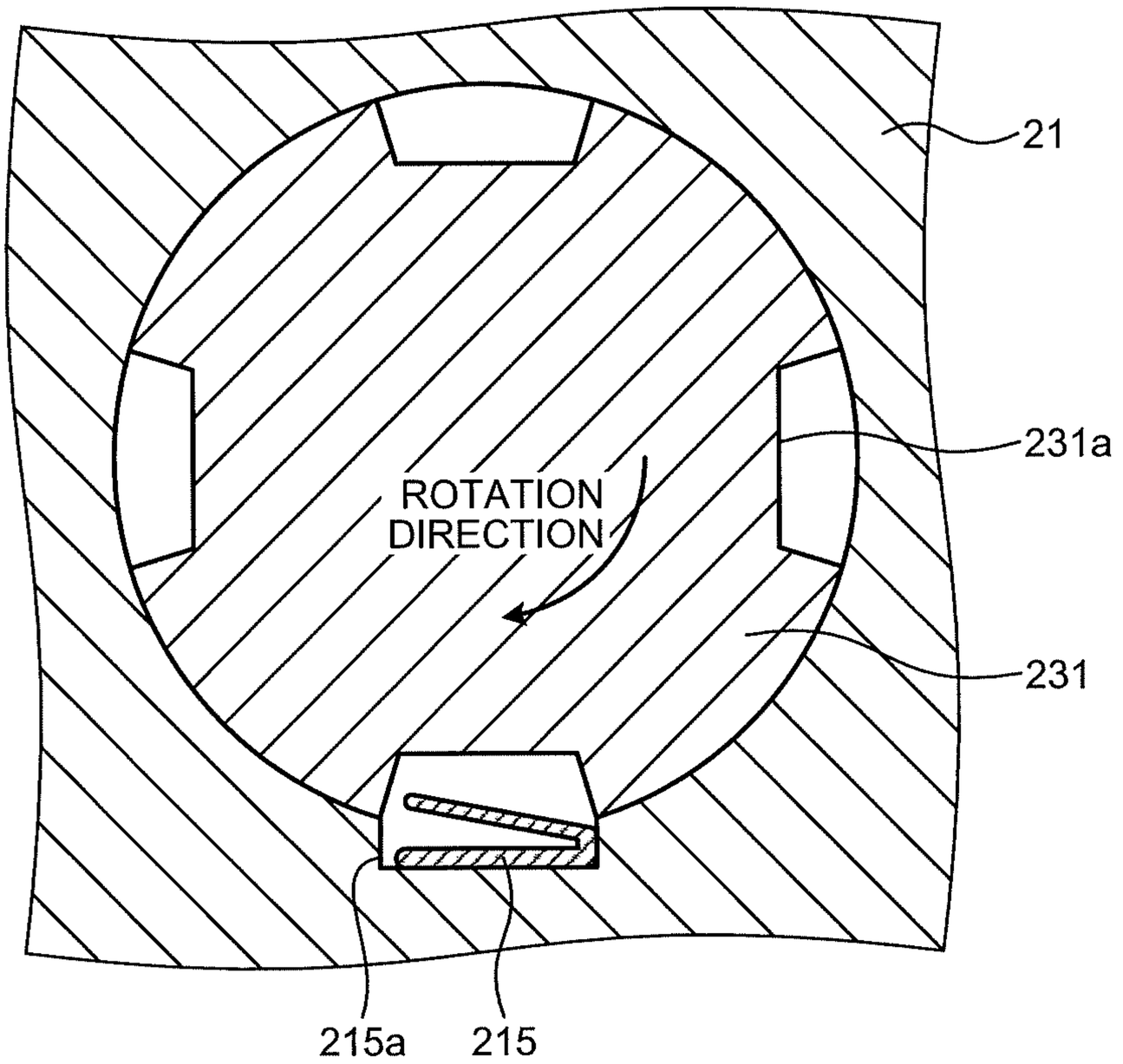

Y2
115
113
Y1
213
24
21
213a
20
117
233
231
23
23a
2
ROTATION DIRECTION
214
116b
112a
211
112g
112f
1
111a
110
111
112g
221
112
117a
116c
116
22
116a
24

FIG.8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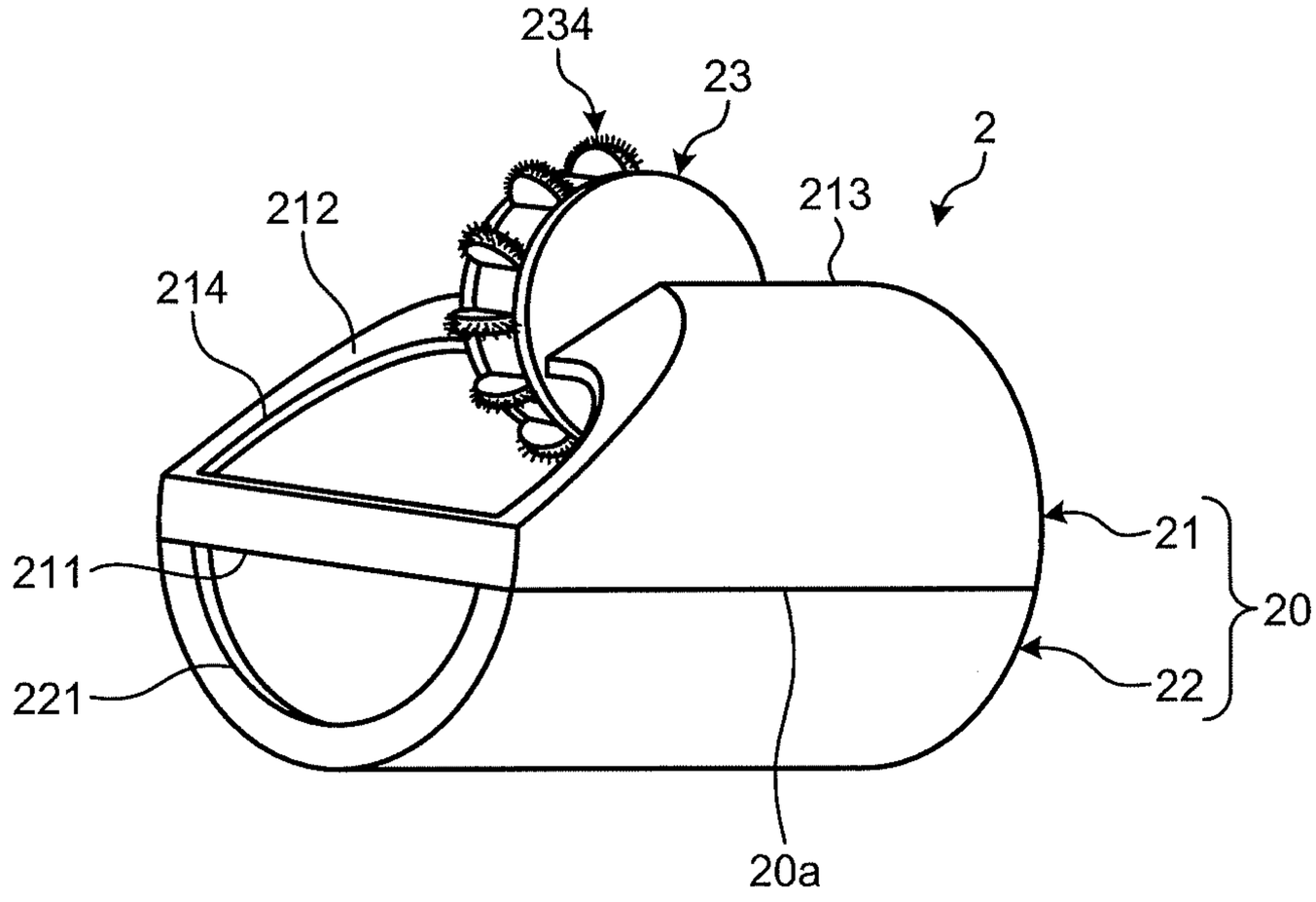
ROTATION
DIRECTION
231
215a
215

FIG.9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23
2
212
213
214
211
221
21
20
22
20a

FIG.10

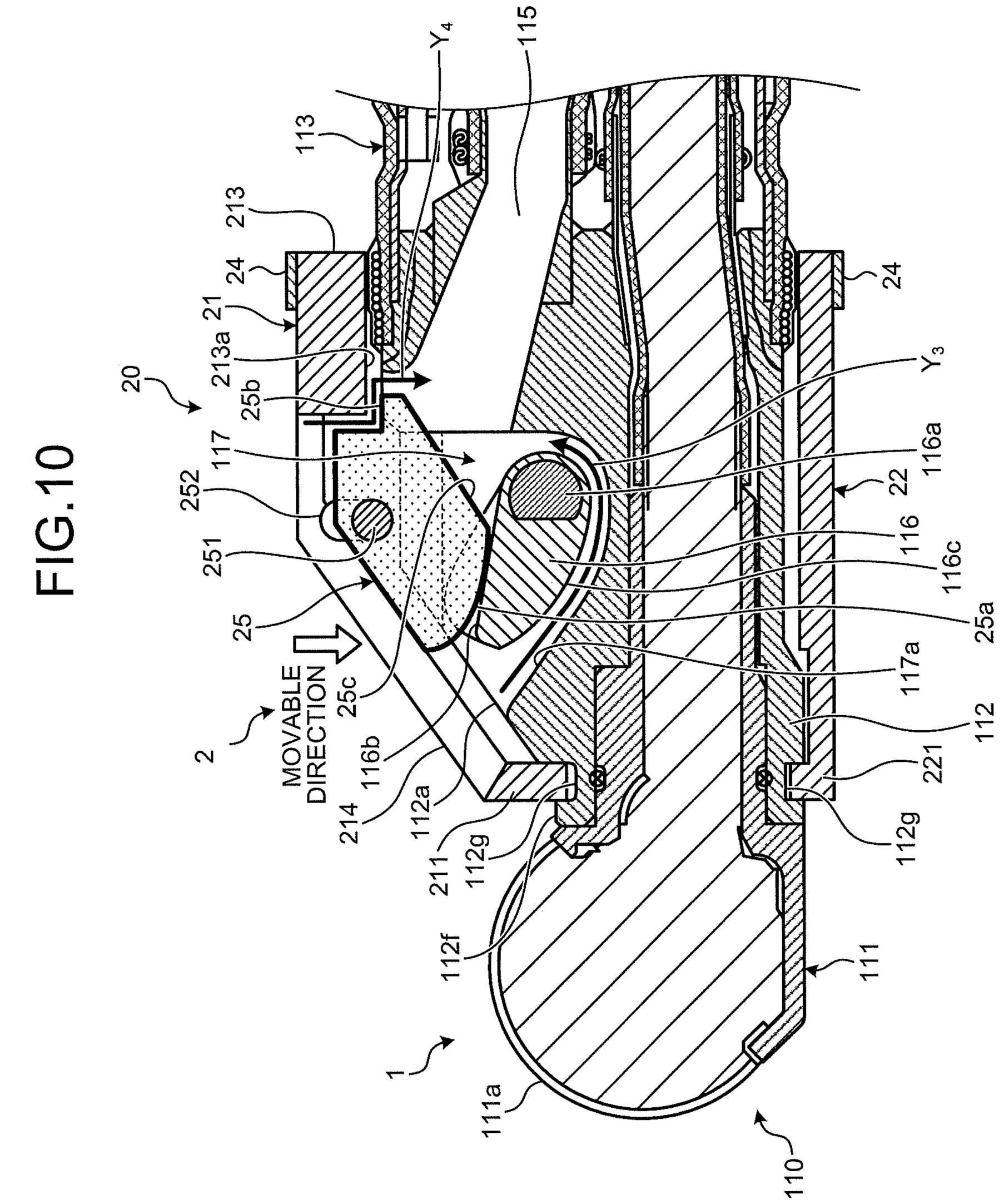
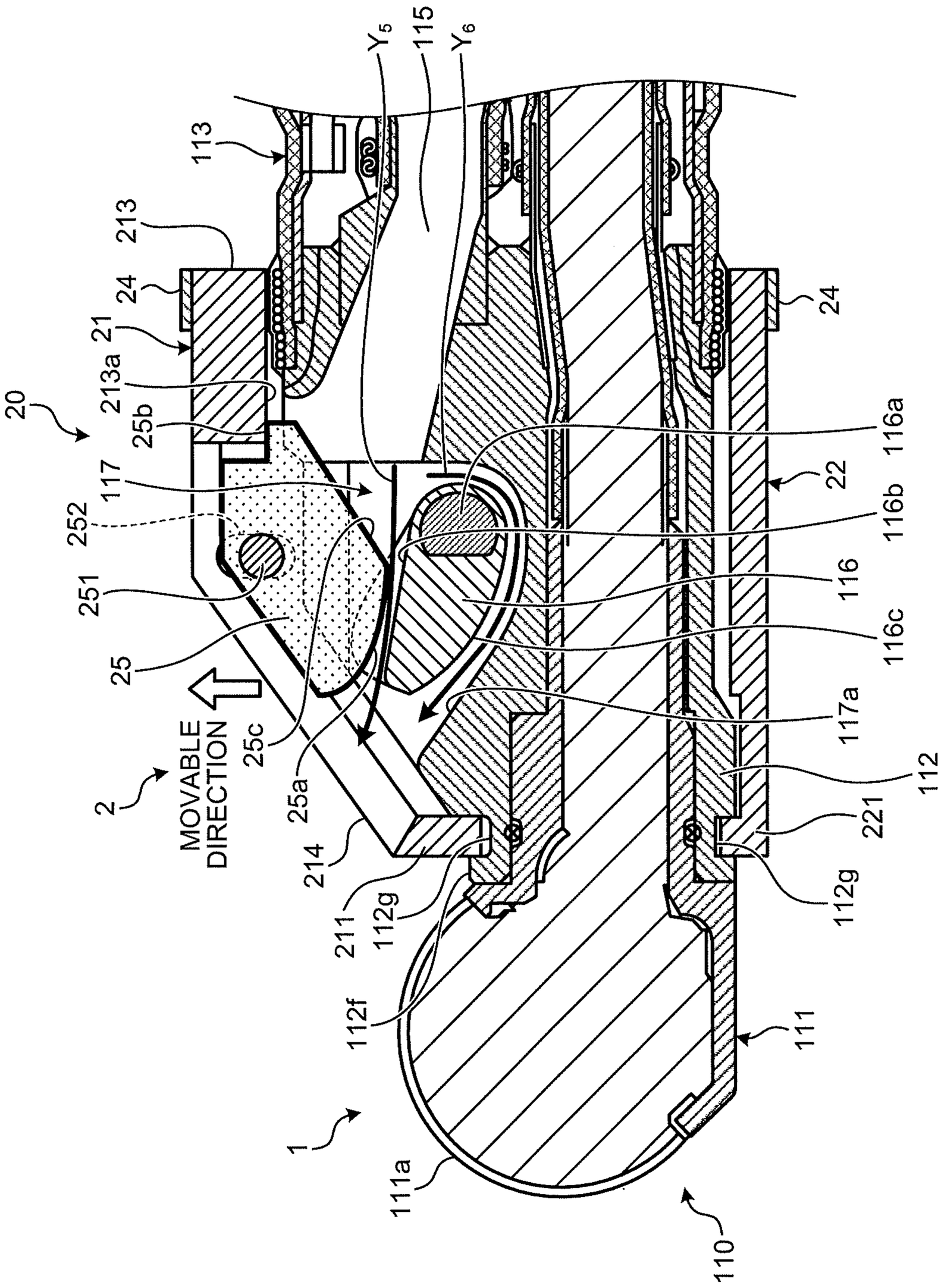

Y_4
115
113
213
24
21
213a
25b
20
117
252
251
25
MOVABLE DIRECTION
25c
2
116b
214
112a
211
112g
112f
1
111a
110
111
112g
221
112
117a
25a
116c
116
22
116a
Y_3
24

FIG.11


Y5
115
Y6
113
213
24
21
213a
25b
20
117
252
251
25
25c
MOVABLE DIRECTION
2
25a
214
211
112g
112f
1
111a
110
111
112g
221
112
117a
116c
116
116b
116a
22
24

ENDOSCOPE TIP ATTACHMENT

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of PCT International Application No. PCT/JP2017/011279 filed on Mar. 21, 2017 which claims the benefit of priority from Japanese Patent Application No. 2016-141787, filed on Jul. 19, 2016, the entire contents of which are incorporated herein by reference.

BACKGROUND

1. Technical Field

The present disclosure relates to an endoscope tip attachment that is attached to a distal end of an endoscope.

2. Related Art

Endoscopes require to be cleaned and sterilized at each use. For example, Japanese Laid-open Patent Publication No. 7-255666 describes that a portion at which a forceps raising base is arranged at a distal end of an endoscope is cleaned by using a syringe jetting out cleaning solution when an endoscope is cleaned.

SUMMARY

In some embodiments, an endoscope tip attachment includes: a cylindrical casing that is arranged to surround a distal end portion of an endoscope that includes a raising base to raise a treatment tool; and a fluid controller that is positioned at an opening of a treatment-tool insertion channel of the endoscope inside the casing in a state in which the casing is attached to the distal end portion of the endoscope, the fluid controller being configured to control a flow of solution that has flowed from the treatment-tool insertion channel of the endoscope toward the distal end portion of the endoscope to flow equally along an entire surface of the raising base provided at the distal end portion of the endoscope, and being movable by pressure received from the solution.

The above and other features, advantages and technical and industrial significance of this disclosure will be better understood by reading the following detailed description of presently preferred embodiments of the disclosure, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** schematically shows an example of an endoscope;

FIG. **2** is a perspective view schematically showing a structure of a distal end portion of the endoscope;

FIG. **3** is a perspective view schematically showing an entire structure of an endoscope tip attachment according to a first embodiment;

FIG. **4** schematically shows a state in which the endoscope tip attachment according to the first embodiment is attached to the distal end portion of the endoscope, viewed from a distal end side;

FIG. **5** shows a view from a direction of an arrow A in FIG. **4**;

FIG. **6** is a partial cross-section including a section taken along a line B-B in FIG. **5**;

FIG. **7** is a cross-section taken along a line C-C in FIG. **5**;

FIG. **8** is a cross-section schematically showing an example of a non-return structure;

FIG. **9** is a perspective view schematically showing an entire structure of an endoscope tip attachment according to a modification of the first embodiment;

FIG. **10** is a diagram for explaining an endoscope tip attachment according to a second embodiment; and

FIG. **11** is a diagram for explaining a flow of solution when an endoscope is cleaned by using the endoscope tip attachment according to the second embodiment.

DETAILED DESCRIPTION

An endoscope tip attachment in a form (hereinafter, "embodiment") to implement the disclosure is specifically explained hereafter, referring to the drawings.

1. First Embodiment

An endoscope tip attachment according to a first embodiment is explained, referring to FIG. **1** to FIG. **7**. A structure of an endoscope to which the endoscope tip attachment is attached is first explained herein, and a structure of the endoscope tip attachment is subsequently explained.

1-1. Endoscope

FIG. **1** schematically shows an example of the endoscope. FIG. **2** is a perspective view schematically showing a structure of a distal end portion of the endoscope. An endoscope **1** shown in FIG. **1** and FIG. **2** is an ultrasound endoscope that transmits ultrasonic waves to a subject to be observed, and that receives ultrasonic waves reflected by the subject.

As shown in FIG. **1**, the endoscope **1** includes a tubular insertion portion **11** to be inserted into a subject, an operation portion **12** that is provided at a proximal end portion of the insertion portion **11**, and that is held by a user and accepts an operation input from the user, and a universal cord **13** that extends from the operation portion. The universal cord **13** includes plural signal cables, an optical fiber that transmits illumination light generated by a light source device (not shown), and the like.

The insertion portion **11** includes a distal end portion (distal end hard portion) **110**, an exterior of which is covered with a hard member, a bending portion **113** that can be bent according to an operation input accepted by the operation portion **12**, and a flexible tube portion **114**, an exterior of which is covered with a member having flexibility. The distal end portion **110** is constituted of a first hard portion **111** that includes an ultrasound probe **111***a* (shown in FIG. **2**), and a second hard portion **112** that includes an optical component. Moreover, inside the insertion portion **11**, a treatment tool channel **115** that is a channel to insert therein a treatment tool, such as a forceps and a puncture needle, is formed. A structure of the distal end portion **110** is described later with reference to FIG. **2**.

In the operation portion **12**, a treatment tool inlet **121** to insert a treatment tool is provided. A treatment tool is inserted through the treatment tool inlet **121** to the treatment tool channel **115**, and protrudes outside from a treatment tool opening **112***a* (shown in FIG. **2**) that is formed in the second hard portion **112** of the distal end portion **110**.

Although not shown, a connector is arranged at an end portion of the universal cord **13** on the opposite side to the operation portion **12**. The universal cord **13** is connected to an ultrasound observation apparatus, a camera control unit, a display device, a light source device, and the like (not shown) via the connector. Furthermore, inside the insertion

portion **11**, a light guide that transmits illumination light supplied by the light source device and multiple signal cables that transmit various kinds of signals are arranged.

As shown in FIG. **2**, in the distal end portion **110**, the first hard portion **111** on a distal end side and the second hard portion **112** on a proximal end side are joined. In the first hard portion **111**, the convex ultrasound probe **111***a* is provided on the distal end side. The first hard portion **111** protrudes toward the distal end side from the second hard portion **112**. The ultrasound probe **111***a* is not limited to be of a convex type, but can be of a linear type also.

The second hard portion **112** has an inclined portion **112***b* that inclines toward the proximal end side from the distal end side. In the inclined portion **112***b*, the treatment tool opening **112***a* that communicates with the treatment tool channel **115**, an objective lens **112***c* that collects light from outside to guide it to an imaging optical system, an illumination lens **112***d* that is positioned on distal end side of the light guide and emits illumination light, and air/water supply nozzle **112***e* are provided.

The treatment tool opening **112** is an opening on the distal end side of the treatment tool channel **115**, and opens to part of the inclined portion **112***b*. Inside the treatment tool opening **112***a*, a raising base **116** enabled to change a protrusion direction of a treatment tool is arranged. By an operation input to the operation portion **12**, the raising base **116** rotates to change a raising angle. The raising base **116** rotates about a supporting axis **116***a* shown in FIG. **7** described later to switch between a raised state and a laid state of a portion on the distal end side.

As shown in FIG. **2**, the raising base **116** includes a mounting surface **116***b* on which at treatment tool is put on, and is housed inside a housing room **117** formed in the second hard portion **112**. The housing room **117** is space, a distal-end-side opening of which is the treatment tool opening **112***a*, and a proximal-end-side opening (not shown) of the housing room **117** communicates with the treatment tool channel **115**. The raising base **116** inside the housing room **117** is arranged such that the mounting surface **116***b* faces toward the treatment tool opening **112***a*.

Moreover, at a distal end portion of the second hard portion **112**, a neck portion **112***f* that is a part joining with the first hard portion **111** is arranged. The neck portion **112***f* is a tubular member, and holds the signal cable connected to the ultrasound probe **111***a*, an insulating pipe wrapping the signal cable, and the like therein. On an outer peripheral portion of the neck portion **112***f*, a balloon groove **112***g* is arranged around an entire perimeter thereof. The balloon groove **112***g* is a ring-shaped groove, and is a portion in which a band portion of a balloon fits when a balloon is attached to the endoscope **1**. Ata cleaning of the endoscope **1**, an endoscope tip attachment **2** (shown in FIG. **3**) fits in the balloon groove **112***g*.

On the other hand, at a proximal end portion of the second hard portion **112**, a non-inclined portion **112***h* that is a part joining with the bending portion **113** is arranged. The non-inclined portion **112***h* has an outer peripheral portion in a cylindrical shape extending from a proximal end side toward a distal end side, and is formed on the proximal end side relative to the inclined portion **112***b*. In the non-inclined portion **112***h*, part of the treatment tool opening **112***a* is arranged.

1-2. Attachment

Next, a structure of the endoscope tip attachment **2** is explained, referring to FIG. **3** to FIG. **7**. FIG. **3** is a perspective view schematically showing an entire structure of the endoscope tip attachment **2** according to the first embodiment. FIG. **4** schematically shows a state in which the endoscope tip attachment **2** according to the first embodiment is attached to the distal end portion **110** of the endoscope **1**, viewed from the distal end side. FIG. **5** shows a view from a direction of an arrow A in FIG. **4**. FIG. **6** is a partial cross-section including a section taken along a line B-B in FIG. **5**. FIG. **7** is a cross-section taken along a line C-C in FIG. **5**.

As shown in FIG. **3**, the endoscope tip attachment (hereinafter, simply "attachment") **2** in the first embodiment includes a tubular casing **20** that has openings at both ends, and a water wheel **23** as a fluid controller. The fluid controller is a member that controls a flow of solution inside the casing at cleaning of the endoscope **1**, and is a movable member that is moved by pressure applied by solution.

The casing **20** includes a first casing **21** to which the water wheel **23** is attached, and a second casing **22** that is detachable with respect to the first casing **21** at a joint portion **20***a*. The casing **20** is structured to be separated into two pieces at the joint portion **20***a*. In a state in which the attachment **2** is attached to the distal end portion **110** of the endoscope **1**, the first casing **21** and the second casing **22** are connected into one piece with the joint portion **20***a*. When the attachment **2** is removed from the distal end portion **110** of the endoscope **1**, the first casing **21** and the second casing **22** are separated at the joint portion **20***a*. For example, the joint portion **20***a* includes an engaging portion (not shown) in concave and convex shapes respectively arranged at end portions in a perimeter direction of the respective casings **21**, **22**. In this explanation, a state in which the attachment **2** is attached to the distal end portion **110** of the endoscope **1** is described as "attached state", and "cleaning solution" is simply described as "solution".

The first casing **21** includes a first fitting portion **211** in which the distal end portion **110** of the endoscope **1** fits, an inclined portion **212** that is inclined from the distal end side toward the proximal end side, and a semicylindrical portion **213** that forms a portion on the proximal end side relative to the inclined portion **212**. The first fitting portion **211** is formed by a portion in the distal end portion of the first casing **21** linearly extending in a diameter direction of the casing **20**. The first fitting portion **211** is a positioning portion that comes in contact with the distal end portion **110** of the endoscope **1**, and fits in the balloon groove **112***g* of the endoscope **1**. The inclined portion **212** has a shape that is inclined along the inclined portion **112***b* of the endoscope **1**. In the inclined portion **212**, an opening window **214** that is formed with a through hole is arranged. In the attached state, the inclined portion **212** of the first casing **21** faces the inclined portion **112***b* of the endoscope **1**, and solution to clean the endoscope **1** flows outside of the casing **20** through the opening window **214**. The semicylindrical portion **213** is arranged on an outer periphery side of the non-inclined portion **112***h* of the second hard portion **112** in the attached state.

The second casing **22** is formed in a semicylindrical shape as its entire shape, and includes a second fitting portion **221** that fits with the distal end portion **110** of the endoscope **1**. The second fitting portion **221** is formed by a portion in the distal end portion of the second casing **22** protruding toward the inside in a diameter direction of the casing **20**. The second fitting portion **221** is a positioning portion that comes in contact with the distal end portion **110** of the endoscope **1**, and fits in the balloon groove **112***g* of the endoscope **1**. The second casing **22** is arranged to cover a rear surface of the second hard portion **112** in the attached state.

The water wheel **23** is rotatably arranged to make relative rotation with respect to the first casing **21** in a state in which part thereof is positioned outside the casing **20**. At cleaning of the endoscope **1**, the water wheel **23***a* receives pressure from solution to obtain a rotation torque to rotate.

As shown in FIG. **4**, the water wheel **23** includes a supporting axis **231** that is attached to the first casing **21**, two pieces of rotating plates **232** in a disk shape that are supported by the supporting axis **231**, and a blade wheel **233** that is sandwiched between the two pieces of rotating plates **232** and has plural blades arranged at uniform intervals along a perimeter direction of the rotating plates **232**. The supporting axis **231**, the two pieces of rotating plates **232**, and the blade wheel **233** rotate together.

The supporting axis **231** penetrates through the two pieces of rotating plates **232** at the center, and is arranged such that both end portions are rotatable to make relative rotation with respect to the first casing **21**, on outer sides of the respective rotating plates **232**. The two pieces of rotating plates **232** are arranged to sandwich the blade wheel **233** from respective sides in an axial direction of the supporting axis **231**. The blade wheel **233** is a portion that receives solution at cleaning, and is supported by the supporting axis **231**. The blades included in the blade wheel **233** are all protruded outward in a diameter direction from an outer diameter of the rotating plates **232**. An outer periphery portion **23***a* of the water wheel **23** is formed in a curved shape in which a diameter gradually increases from respective end sides toward a center side in the axial direction of the supporting axis **231**.

The outer periphery portion **23***a* of the water wheel **23** is structured to be able to come in contact with the mounting surface **116***b* of the raising base **116** inside the casing **20** in the attached state. As shown in FIG. **4**, the mounting surface **116***b* of the raising base **116** is formed to have a curved surface in which a central portion is recessed compared to both end portions in a width direction of the raising base **116** (the axial direction of the supporting axis **231**) when the endoscope **1** is viewed from the distal end side. The outer periphery portion **23***a* of the water wheel **23** has a shape that a central portion rises compared to both end portions in a width direction thereof. That is, the outer periphery portion **23***a* of the water wheel **23** is formed in a shape along (shape corresponding to) the mounting surface **116***b* to be in contact in the axial direction of the supporting axis **231**. When the outer periphery portion **23***a* of the water wheel **23** and the raising base **116** are able to be in contact with each other, the blades of the blade wheel **233** are structured with flexible members. In this case, when the water wheel **23** rotates, the outer periphery portion **23***a* of the water wheel **23** having flexibility can slide on the mounting surface **116***b* of the raising base **116**.

As shown in FIG. **5**, in the attached state, the attachment **2** is arranged to surround the distal end portion **110** (at least the second hard portion **112**) of the endoscope **1**. The ultrasound probe **111***a* is positioned outside the casing **20**, and the raising base **116** is positioned inside the casing **20**. A distal end portion of the attachment **2** is structured in a form in which the treatment tool opening **112***a* is seen through the opening window **214** of the first casing **21**. The opening window **214** is arranged between a portion at which the water wheel **23** is attached and the first fitting portion **211**. The opening window **214** is formed in a shape in which a part thereof is curved to be narrower toward the proximal end side from the distal end side. Furthermore, the semicylindrical portion **213** that is a proximal end portion of the attachment **2** is fastened on an outer periphery portion of the non-inclined portion **112***h* of the second hard portion **112** by an elastic ring-shaped member **24**. The ring-shaped member **24** is constituted of a rubber band or the like.

As shown in FIG. **6**, the first fitting portion **211** in a straight shape fits in a part of the balloon groove **112***g*, which is an annular groove. On the other hand, the second fitting portion **221** in a curved shape fits in a part of the balloon groove **112***g* different from the part in which the first fitting portion **211** fits. Thus, the attachment **2** is engaged therein not to move toward a distal end direction and a proximal end direction with respect to the endoscope **1** in the attached state.

Referring to FIG. **7**, a flow of solution at cleaning is explained herein. First, a case in which the attachment **2** is not attached to the distal end portion **110** of the endoscope **1** is explained for comparison. In this case, solution flowing out from the opening of the treatment tool channel **115** flows along the mounting surface **116***b* of the raising base **116** inside the housing room **117** as indicated by an arrow Y_1 in a broken line in FIG. **7**. Because the solution inside the casing **20** flows smoothly in a direction of the arrow Y_1, the solution flows outside the casing **20** through the opening window **214** from the distal end side of the mounting surface **116***b*. That is, without the attachment **2**, as indicated by an arrow Y_2 in a solid line in FIG. **7**, it is unlikely that a situation in which the solution flows in a gap between a rear surface **116***c* of the raising base **116** and a bottom surface **117***a* of the housing room **117** occurs. The rear surface **116***c* is a surface opposite to the mounting surface **116***b*.

On the other hand, in the attached state of the attachment **2**, the water wheel **23** that is a fluid controller is positioned at the opening of the treatment tool channel **115**. In more detail, only one side of the blade of the blade wheel **233** faces the opening of the treatment tool channel **115**. A position at which the blades of the blade wheel **233** is positioned is a position to restrain a direction (indicated by the arrow Y_1) in which solution flowing out from the opening of the treatment tool channel **115** flows toward the distal end side along the mounting surface **116***b* of the raising base **116**. That is, one side of the blade of the blade wheel **233** is a pressure receiving surface that receives pressure of solution flowing out from the opening of the treatment tool channel **115** in the direction of the arrow Y_1. Furthermore, the water wheel **23** is structured to have a rotational resistance to a flow of solution. For example, the supporting axis **231** is attached to slide on the first casing **21** to generate a rotational resistance of the water wheel **23**. Therefore, it is possible to restrain smooth flow of solution that has flowed out from the opening of the treatment tool channel **115** along the mounting surface **116***b* of the raising base **116** inside the housing room **117** by the water wheel **23**. Thus, the solution inside the housing room **117** is likely to flow in the gap between the rear surface **116***c* of the raising base **116** and the bottom surface **117***a* of the housing room **117** as indicated by the arrow Y_2, separately from the direction of flow along the mounting surface **116***b* indicated by the arrow Y_1. When a flow amount to the inside of the casing **20** from the opening of the treatment tool channel **115** is the same, it is possible to increase a flow amount of solution that flows on a side of the rear surface **116***c* indicated by the arrow Y_2 by limiting the flow mount (decreasing a flow speed) of solution that flows on a side of the mounting surface **116***b* indicated by the arrow Y_1 by the water wheel **23**. Moreover, in a portion on the proximal end side relative to the water wheel **23** out of the first casing **21**, a part of an inner surface **213***a* of the semicylindrical portion **213** protrudes inward in the diameter direction. In the

attached state, the protruding inner surface **213***a* is positioned inside the treatment tool opening **112***a* that opens to the non-inclined portion **112***h* of the second hard portion **112**. Furthermore, the proximal end portion out of the semicylindrical portion **213** is fastened on its outer periphery by the ring-shaped member **24** together with the proximal end portion of the second casing **22**, and the inner periphery portion is in contact with the bending portion **113**. This facilitates flow of solution flowing out from the opening of the treatment tool channel **115** to flow in the direction indicated by the arrow Y_1.

For example, when the water wheel **23** is not moving during cleaning, a flow of solution indicated by the arrow Y_1 does not occur, and the solution flows only in a gap at a portion at which a surface (excluding the mounting surface **116***b*) of the raising base **116** and a wall surface of the housing room **117** (including the flow indicated by the arrow Y_2) face each other. When the water wheel **23** is then rotated by pressure of solution coming from a direction of the treatment tool channel **115**, the flow indicated by the arrow Y_1 occurs in addition to the flow of solution indicated by the arrow Y_2. Moreover, the supporting axis **231** positioned in a rotation center of the water wheel **23** is arranged at a position enabling rotation of the water wheel **23** only in one direction by solution flowing from the opening of the treatment tool channel **115**. Therefore, the water wheel **23** rotates only in one direction as a result of occurrence of the flow indicated by the arrow Y_1 inside the first casing **21** at cleaning. That is, the water wheel **23** rotates only in a direction in which solution in the housing room **117** flows outside the first casing **21** through the opening window **214**. This enables to suppress backflow of solution that has been used to clean the raising base **116** in the housing room **117** to the housing room **117** that has already been cleaned.

Furthermore, as shown in FIG. **6**, the raising base **116** is arranged not to be in contact with a side surface **117***b* of the housing room **117**. Therefore, a narrow gap is formed at a portion at which the side surface **117***b* of the housing room **117** and a side surface **116***d* of the raising base **116** face each other. When the flow of solution indicated by the arrow Y_2 occurs as described above, it is possible to feed solution not only to the narrow gap at the portion at which the rear surface **116***c* of the raising base **116** and the bottom surface **117***a* of the housing room **117** face each other, but also into the narrow gap at the portion at which the side surface **116***d* of the raising base **116** and the side surface **117***b* of the housing room **117** face each other.

As described, by making cleaning solution flow from the treatment tool channel **115** toward the distal end portion **110**, the mounting surface **116***b* of the raising base **116** can be cleaned, and the solution can be fed also into the narrow gap between a surface (the rear surface **116***c* and the side surface **116***d*) of the raising base **116** and a wall surface (the bottom surface **117***a* and the side surface **117***b*) of the housing room **117**. Thus, it is possible to make solution flow to every corner of a narrow gap formed in the distal end portion **110** that includes the raising base **116**, and to clean the surface (the mounting surface **116***b*, the rear surface **116***c*, and the side surface **116***d*) of the raising base **116** housed in the housing room **117** easily with just one feed of water.

As explained above, according to the first embodiment, a flow of solution inside the casing **20** can be restrained (controlled) by the water wheel **23**, which is the fluid controller and, therefore, it is possible to promote a flow of solution flowing into a narrow gap between the housing room **117** and the raising base **116**. Moreover, because the water wheel **23** is rotatable, solution flows along the mounting surface **116***b* of the raising base **116** as the water wheel **23** rotates. Thus, by making the cleaning solution flow from the treatment tool inlet **121** of the treatment tool channel **115** of the endoscope **1** toward the treatment tool opening **112***a*, a flow of solution along the entire surface of the raising base **116** occurs. Therefore, it is possible to distribute solution equally to a narrow gap between the raising base **116** and the housing room **117** and to make the cleaning process of the distal end portion **110** of the endoscope **1** easy.

It is not limited to a structure that a rotational resistance of the water wheel **23** is generated by the supporting axis **231** sliding on the first casing **21**. For example, the attachment **2** in which a rotational resistance of the water wheel **23** is generated by the outer periphery portion **23***a* of the water wheel **23** sliding on the mounting surface **116***b* of the raising base **116** can be structured. Alternatively, it can be structured such that a rotational resistance of the water wheel **23** is generated by the outer periphery portion **23***a* of the water wheel **23** sliding a part of the first casing **21**. Furthermore, as for the structure of limiting the rotation direction of the water wheel **23** to one direction, it is not limited to the case in which the supporting axis **231** is positioned at such a position that the water wheel **23** is rotated by a flow of solution only in one direction described above. For example, it can be structured such that a non-return structure, such as a latch, is provided in the supporting axis **231** so that the water wheel **23** rotates only in one direction. FIG. **8** is a cross-section schematically showing an example of a non-return structure. As shown in FIG. **8**, a non-return structure in which the supporting axis **231** rotates only in one direction can be structured by arranging a blade spring **215** at an attaching portion of the first casing **21** and the supporting axis **231**. In this case, in the first casing **21**, a housing concave portion **215***a* to house the blade spring **215** is formed. At an outer periphery portion of the supporting axis **231**, plural engaging concave portions **231***a* are formed at predetermined intervals along a perimeter direction. The blade spring **215** is arranged inside the housing concave portion **215***a*, pushed down toward the housing concave portion **215***a* when the supporting axis **231** rotates in a forward direction (one direction described above). That is, when the supporting axis **231** is about to rotate in a reverse direction, the blade spring **215** protrudes out toward the supporting axis **231** to engage with the engaging concave portion **231***a*. Thus, the supporting axis **231** becomes rotatable in the forward direction, and the reverse rotation of the supporting axis **231** is restrained.

Moreover, the outer periphery portion **23***a* of the water wheel **23** is not necessarily required to be in contact with the mounting surface **116***b* of the raising base **116**. The attachment **2** is only required to be structured such that a gap between the outer periphery portion **23***a* of the water wheel **23** and the mounting surface **116***b* of the raising base **116** is narrow in the attached state. That is, it is only necessary to arrange the blade wheel **233** so that the gap is narrow, and a flow of solution indicated by the arrow Y_1 in FIG. **7** described above can be controlled. Therefore, the attachment **2** can also be structured such that the water wheel **23** and the raising base **116** are not in contact with each other in the attached state.

Furthermore, the shape of the opening window **214** is not limited to the partially curved shape described above, and can be changed to a rectangular shape, a circular shape, or the like as appropriate. Moreover, the water wheel **23** can be

structured with a rotating body, such as a gear, not having two pieces of rotating plates **232** as side plates.

2. Modification of First Embodiment

FIG. **9** is a perspective view schematically showing an entire structure of the attachment **2** according to a modification of the first embodiment. As shown in FIG. **9**, a cleaning brush **234** is provided in the water wheel **23** in the modification of the first embodiment described above. The brush **234** is made from a material having flexibility, such as an elastic member. Moreover, the brush **234** is made into one piece with the water wheel **23**, and protrudes outward in a diameter direction from an outer periphery portion of the blade wheel **233**. When this water wheel **23** rotates, the brush **234** slides on the mounting surface **116***b* of the raising base **116**. The brush **234** can be arranged in a whole area of the outer periphery portion **23***a*, or can be arranged in part of the outer periphery portion **23***a*. Furthermore, the brush **234** can be arranged to be integrated in a portion between blades of the blade wheel **233** in a perimeter direction to protrude further outward in the diameter direction than the blades.

According to the attachment **2** of the modification, the brush **234** can rub to clean the mounting surface **116***b* of the raising base **116** as the water wheel **23** rotates. This produces a cleaning effect by the water wheel **23** with a brush in addition to the cleaning effect by a flow of solution.

3. Second Embodiment

The attachment **2** according to a second embodiment is explained, referring to FIG. **10** and FIG. **11**. FIG. **10** is a diagram for explaining the attachment **2** according to the second embodiment. FIG. **11** is a diagram for explaining a flow of solution when the endoscope **1** is cleaned by using the attachment **2** according to the second embodiment. In explanation of the second embodiment, explanation about components similar to those of the first embodiment is omitted, and the reference symbols thereof are used.

AS shown in FIG. **10**, the attachment **2** of the second embodiment includes a valve member **25** that is movable by pressure of solution, in place of the water wheel **23** in the first embodiment. The valve member **25** is a fluid controller, and is attached to the first casing **21** through a supporting member **251** in a state of being housed inside the first casing **21**. The supporting member **251** is attached to a guide groove **252** provided in the first casing **21**. The valve member **25** and the supporting member **251** are moving objects that integrally move, and are movable in an up-and-down direction (movable direction indicated by an arrow) in FIG. **10** and FIG. **11** along the guide groove **252** linearly formed. For example, the supporting member **251** is constituted of an axial member that penetrate through the valve member **25**, and fits in the guide groove **252** at both ends of the axial member. Moreover, the valve member **25** is housed inside the first casing **21**. The raising base **116** functions as a first valve mount of the valve member **25**, and the semicylindrical portion **213** of the first casing **21** functions as a second valve mount of the valve member **25**.

In detail, the valve member **25** has a bottom surface **25***a* that comes in contact with the mounting surface **116***b* of the raising base **116**, a top surface **25***b* that comes in contact with the inner surface **213***a* of the semicylindrical portion **213**, and a pressure receiving surface **25***c* that faces the opening of the treatment tool channel **115**. Moreover, the valve member **25** includes an inclined surface that inclines along the inclined portion **212** of the first casing **21**.

The bottom surface **25***a* is curved in a convex shape toward the raising base **116** from the distal end side to the proximal end side of the valve member **25**. Furthermore, the bottom surface **25***a* is curved along the shape of the mounting surface **116***b* of the raising base **116** (shown in FIG. **6**) in a width direction (the axial direction of the supporting axis **116***a*) of the raising base **116**. In a state in which the bottom surface **25***a* is in contact with the mounting surface **116***b* as shown in FIG. **10**, the valve member **25** is in a first state (a settled state at sucking) of being in contact with the raising base **116**, not in Contact with the inner surface **213***a* of the semicylindrical portion **213** in the first casing **21**. In this first state, a flow of solution along the mounting surface **116***b* of the raising base **116** is interrupted. On the other hand, the valve member **25** and the raising base **116** are not in contact with each other (in a case of a second state described later), the flow is not interrupted.

The top surface **25***b* is included in a portion protruding toward the proximal end side in the valve member **25**, and has a shape along the inner surface **213***a* of the semicylindrical portion **213**. Furthermore, in a diameter direction of the casing **20**, the top surface **25***b* and the inner surface **213***a* face each other. In a state in which the top surface **25***b* and the inner surface **213***a* are in contact with each other as shown in FIG. **11**, the valve member **25** is in the second state of being not in contact with the raising base **116**, but in contact with the semicylindrical portion **213** (a settled state at water feeding). In this second state, a flow of solution along the top surface **25***b* from the outside of the semicylindrical portion **213** toward the inside of the first casing **21** is interrupted. On the other hand, when the valve member **25** and the semicylindrical portion **213** are not in contact with each other (in the first state described above), the flow is not interrupted. As described, the attachment **2** in the second embodiment is structured to be able to switch between the first state and the second state.

Moreover, the pressure receiving surface **25***c* is a surface that receives pressure of solution that has flowed out from the opening of the treatment tool channel **115**, and is inclined toward the distal end side from the proximal end side. The valve member **25** is structured such that a direction in which the distal end portion **110** of the endoscope **1** extends (the direction toward the distal ends side from the proximal end side) and the movable direction of the valve member **25** intersect each other because the valve member **25** moves by pressure of solution received on the pressure receiving surface **25***c*. Therefore, the pressure receiving surface **25***c* extends to a lower part of a portion at which the valve member **25** and the supporting member **251** are connected, and the inclined direction of the pressure receiving surface **25***c* is set to a direction intersecting the movable direction of the valve member **25**.

A flow of solution at cleaning is explained herein, referring to FIG. **10** and FIG. **11**.

The state shown in FIG. **10** is a case of cleaning the distal end portion **110** of the endoscope **1** in cleaning solution, and is a state in which solution outside the casing **20** is sucked from the opening of the treatment tool channel **115** by sucking solution inside the treatment tool channel **115** from the treatment tool inlet **121** (shown in FIG. **1**). When solution inside the casing **20** is sucked from the opening of the treatment tool channel **115**, pressure of solution by suction acts on the pressure receiving surface **25***c* to move the valve member **25** to approach to the raising base **116**. The valve member **25** then comes in contact with (settled on)

the raising base **116**. By thus closing the gap between the mounting surface **116***b* of the raising base **116** and the bottom surface **25***a* of the valve member **25** with the valve member **25** at the distal end side the raising base **116**, the flow of solution is restrained. In this case, solution that has flowed inside the casing **20** through the opening window **214** from the outside of the casing **20** is to flow through a gap between the surface of the raising base **116** (the rear surface **116***c* and the side surface **116***d*) and the wall surface (the bottom surface **117***a* and the side surface **117***b*) of the housing room **117**. That is, a flow of solution indicated by an arrow Y_3 in FIG. **10** occurs, and the solution flows from the distal end side to the proximal end side along the rear surface **116***c* of the raising base **116**. As a result, solution outside the casing **20** is sucked into the treatment tool channel **115** through a portion on a side of the rear surface **116***c* of the raising base **116**. The arrow Y_3 shown in FIG. **10** indicates a direction in which solution flows in the gap at the portion at which the surface (excluding the mounting surface **116***b*) of the raising base **116** and the wall surface of the housing room **117** face each other. On the other hand, as the bottom surface **25***a* of the valve member **25** and the mounting surface **116***b* of the raising base **116** come in contact with each other, a gap is generated between the top surface **25***b* of the valve member **25** and the inner surface **213***a* of the proximal end portion (the semicylindrical portion **213**) of the first casing **21**. Therefore, solution outside the casing **20** flows into the inside of the casing **20** also through another path different from the path of flowing from the distal end side of the raising base **116** described above. As indicated by an arrow Y_4 in FIG. **10**, solution outside the casing **20** flows into the treatment tool channel **115** through a gap between the top surface **25***b* and the inner surface **213***a*. The arrow Y_4 shown in FIG. **10** indicates a direction in which solution flows through a gap at the portion at which the top surface **25***b* and the inner surface **213***a* of the semicylindrical portion **213** face each other at the distal end side of the valve member **25**.

The state shown in FIG. **11** is a case in which the distal end portion **110** of the endoscope **1** is cleaned in atmosphere, and is a state in which solution flows in a reverse direction to the flowing direction of the solution shown in FIG. **10** (a water feeding state). The water feeding state is when solution is fed from the treatment tool inlet **121** to flow toward the opening of the treatment tool channel **115** at cleaning. In this case, the valve member **25** moves in a direction opposite to the raising base **116** because it receives pressure of solution flowing out from the opening of the treatment tool channel **115** on the pressure receiving surface **25***c*. Thus, a gap is generated between the bottom surface **25***a* of the valve member **25** and the mounting surface **116***b* of the raising base **116**. As a result, solution flows toward the opening window **214** from the treatment tool channel **115** through the gap as indicated by the arrow Y_5 in FIG. **11**. The arrow Y_5 shown in FIG. **11** indicates a direction in which solution flows through the gap at a portion at which the valve member **25** and the mounting surface **116***b* of the raising base **116** face each other. On the other hand, the gap at a portion at which the valve member **25** and the semicylindrical portion **213** face each other is closed as the inner surface **213***a* on the proximal end side of the first casing **21** and the top surface **25***b* of the valve member **25** come into contact with each other. Therefore, solution that has flowed into the inside of the casing **20** flows through a gap between the rear surface of the raising base **116** and the bottom surface **117***a* of the housing room **117** toward the distal end side from the proximal end side as indicated by the arrow Y_6. The arrow Y_6 in FIG. **11** indicates a direction in which solution flows toward the distal end side from the proximal end side through the gap at the portion at which the surface (excluding the mounting surface **116***b*) of the raising base **116** and the wall surface of the housing room **117** face each other.

As explained above, according to the second embodiment, a flow of solution inside the casing **20** can be controlled by the valve member **25**, which is the fluid controller and, therefore, it is possible to promote a flow of solution flowing into a gap between the housing room **117** and the raising base **116**. Moreover, because the valve member **25** is movable, solution flows along the mounting surface **116***b* of the raising base **116** as the valve member **25** moves away from the raising base **116**. Thus, the cleaning solution flows from the treatment tool channel **115** of the endoscope **1** toward the treatment tool opening **112***a*, and a flow of solution along the entire surface of the raising base **116** from the proximal end side to the distal end side occurs. Alternatively, by sucking solution from the treatment tool channel **115** in a state in which the distal end portion **110** is immersed in cleaning solution, a flow of solution that flows into a narrow gap between the housing room **117** and the raising base **116** from the distal end side toward the proximal end side occurs. As a result, a flow of solution along the entire surface of the raising base **116** occurs. As described, it is possible to distribute solution equally to a narrow gap between the raising base **116** and the housing room **117**, and to make the cleaning process of the distal end portion **110** of the endoscope **1** easy.

In the embodiments described above, a case in which the attachment **2** is attached to the distal end portion **110** in the cleaning process has been explained, but the attachment **2** can be used in a sterilization process of the endoscope also. In this case, "cleaning solution" in the explanation above can be read as "sterilization solution".

Moreover, an endoscope to which the attachment **2** can be attached is not limited to the ultrasound endoscope described above. That is, as long as it is an endoscope having a raising base at a distal end portion, it can be a side-viewing endoscope or an oblique-viewing endoscope. Furthermore, various types of endoscopes to observe digestive canals (the esophagus, the duodenum, the large intestine), respiratory organs (the trachea, the bronchus), and the like of a subject are included.

According to the disclosure, at cleaning of a distal end portion of an endoscope, a flow of solution can be controlled inside a casing by a fluid controller and, therefore, a flow of solution flowing along an entire surface of a raising base can be promoted. Moreover, because the fluid controller is movable, by making cleaning solution flow from a treatment-tool insertion channel of the endoscope toward an opening thereof, a flow of solution along the entire surface of the raising base inside the casing occurs. Thus, it is possible to feed the cleaning solution to every corner equally at the distal end portion of the endoscope having the raising base, to make a cleaning process easy.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the disclosure in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

What is claimed is:

1. An endoscope tip attachment comprising:

a cylindrical casing arranged to surround a distal end portion of an endoscope, the endoscope including a raising base configured to raise a treatment tool; and

a fluid controller having one or more pressure receiving surfaces, the fluid controller being positioned at an opening of a treatment-tool insertion channel of the endoscope in a state in which the casing is attached to the distal end portion of the endoscope, the fluid controller being configured to control a flow of solution that has flowed from the treatment-tool insertion channel of the endoscope toward the distal end portion of the endoscope to flow along a surface of the raising base provided at the distal end portion of the endoscope, the one or more pressure receiving surfaces being movable by pressure received from the solution;

wherein the fluid controller comprises a water wheel attached to the casing through a supporting axis, the water wheel being configured to be rotated by pressure received from the solution flowing out from the opening of the treatment-tool insertion channel toward the distal end portion of the endoscope.

2. The endoscope tip attachment according to claim **1**, further comprising a latch enabling the water wheel to rotate only in one direction at an attachment portion of the supporting axis and the casing.

3. The endoscope tip attachment according to claim **1**, wherein the supporting axis is arranged at a position at which the water wheel is rotated only in one direction by pressure received from the solution flowing out from the opening of the treatment-tool insertion channel toward the distal end portion of the endoscope.

4. The endoscope tip attachment according to claim **1**, wherein the supporting axis is configured to slide on the casing when the water wheel rotates.

5. The endoscope tip attachment according to claim **1**, wherein an outer periphery portion of the water wheel is configured to come in contact with a surface of the raising base.

6. The endoscope tip attachment according to claim **1**, wherein the water wheel has a brush provided in an integrated manner.

7. The endoscope tip attachment according to claim **1**, wherein the casing includes

a fitting portion configured to fit in a groove provided at the distal end portion of the endoscope; and

an opening window provided between a portion at which the fluid controller is attached and the fitting portion.

8. The endoscope tip attachment according to claim **1**, wherein the casing includes

a first casing to which the fluid controller is attached; and

a second casing detachable with respect to the first casing.

9. An endoscope system comprising:

an endoscope having a distal end portion; and

a tip attachment comprising:

a cylindrical casing disposed at a distal end portion of an endoscope, the endoscope including a raising base configured to raise a treatment tool; and

one or more pressure receiving surfaces disposed within the casing and configured to receive a flow of solution from an opening of a treatment-tool insertion channel of the endoscope in a first state in which the casing is attached to the distal end portion of the endoscope;

wherein the raising base having a first surface over which the solution flows in a second state in which the casing is not attached to the distal end portion of the endoscope;

in the first state, the one or more pressure receiving surfaces being configured to move by pressure received from the flow of solution to divert at least a portion of the flow of solution to a second surface of the raising base, the second surface being different from the first surface; and

the one or more pressure receiving surface comprises one or more paddles of a water wheel rotatably arranged on the casing.

10. The endoscope system according to claim **9**, wherein:

the first surface comprises a lifting surface of the raising base configured to raise the treatment tool; and

the second surface comprises an adjacent surface of the lifting base positioned adjacent to a wall of the distal end portion of the endoscope.

* * * * *